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ABSTRACT

A closer look at what actually occurs in classrooms forces observers to realize that to integrate technology effectively into teaching and learning, teachers must address many challenges and demonstrate more than superficial knowledge about technology and its use. To assess one element of the technology integration issue, a regional survey of teachers' software selection and use was conducted. The spring 1999 survey was designed to provide insight into the types of software and frequency of software use in classrooms across Kentucky, Tennessee, Virginia, and West Virginia and to identify issues for further research and technical assistance in the region. Key findings revealed that of those responding to the survey: 83.6% indicated they never use software in their teaching; productivity tools and research tools were the most frequently used software; curriculum software and instructional simulations were the least utilized software; and drill-and-practice software was utilized daily by 9.5% of respondents. The type of software use by subject area is also outlined. Implications for action are discussed. Contains 16 references.) (AEF)

Educational Software Use

Results From a 1999 Regional Survey

R•TEC at AEL

Educational Software Use: Results of a 1999 Regional Survey

October 1999

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Figures

"You can lead a horse to water, but you can't make it drink." It is tempting to resort to this old adage when considering the alarming truth that access to technology and teacher training are not enough to ensure the effective use of technology in classrooms. Larry Cuban (1999), writing in *Education Week*, asks, "Why is greater access to technology not translating into better classroom use?" His commentary urges readers to look beyond blaming teachers and to seek answers waiting to be found in teachers' daily experiences.

A closer look at what actually occurs in classrooms forces observers to realize that to integrate technology effectively into teaching and learning, teachers must address a plethora of challenges and demonstrate more than superficial knowledge about technology and its use. Assuredly, most technology-literate educators stress the importance of utilizing software that complements instructional goals and objectives; however, teacher practices that have been accepted intuitively must be examined more closely if, as Cuban suggests, there are deeper reasons for why technology use is not ubiquitous in schools.

To assess one element of the technology integration issue, SEIR◆TEC at AEL conducted a regional survey of teachers' software selection and use. The spring 1999 survey was designed to provide insight into the types of software and frequency of software use in classrooms across Kentucky, Tennessee, Virginia, and West Virginia and to identify issues for further research and technical assistance in the SEIR◆TEC region.

Teachers often begin the process of computer integration by using software applications that approximate familiar, well-structured classroom activities (Sheingold & Hadley, 1990). This was a key finding in the evaluation of the Apple Classrooms of Tomorrow (ACOT) project (Baker, Gearhart, & Herman, 1993). In this early computer-intensive project, teachers immersed in technology chose resources and based pedagogical decisions upon subject area rather than available technological resources. Teachers started with what was familiar. Those comfortable with class lectures and seatwork began integrating technology with software and activities that mirrored these more traditional classroom techniques. However, as the project continued, teachers involved with this technology-rich program appeared to progress through stages of integration that could more or less be identified and described.

At all of the project's sites, new patterns of teaching and learning evolved in five stages: entry, adoption, adaptation, appropriation, and invention (Dwyer, Ringstaff, & Sandholtz, 1991). Teachers progressed at various rates, with a handful reaching the more advanced stages of appropriation and invention within two years. Sheingold and Hadley (1990), in a study of advanced users not in the ACOT program, confirmed that teachers move through similar evolutions of teaching and learning with technology. These researchers also found that teachers begin with technology that replicates familiar activities. Teachers at the stage described as *entry* typically learn the fundamental aspects of using new technology, including the basics of configuring hardware and software. During the second stage, known as *adoption*, teachers concern themselves with ways to use the technology to support traditional instruction. Similarly, in stage three, the *adaptation* stage, teachers integrate technology into existing classroom activities. The emphasis in this stage, however, is productivity. Students use word processors, databases, and some graphics programs to create familiar products of instruction. It is at the fourth stage, *appropriation*, that teachers begin to develop new approaches to teaching and learning that make the most of the technology available to them. Appropriation occurs when a teacher's mastery and skill level has developed to allow the creation of new learning activities not possible without the technology. Finally, at the fifth stage in the process, *innovation*, teachers no longer try to adapt instruction to technology but adjust their fundamental perceptions of instruction. Teachers who reach this stage reflect on the actual craft of teaching, and their fundamental teaching approach may shift (Dwyer, Ringstaff, & Sandholtz, 1991).

Evolutionary Stages of Technology Integration

1. **Entry**—Teachers typically learn the fundamental aspects of using new technology, including the basics of configuring hardware and software.
2. **Adoption**—Teachers concern themselves with ways to use the technology to support traditional instruction.
3. **Adaptation**—Teachers integrate technology into existing classroom activities. The emphasis is productivity. Students use word processors, databases, and some graphics programs to create familiar products of instruction.
4. **Appropriation**—Teachers begin to develop new approaches to teaching and learning that make the most of the technology available to them. A teacher's mastery and skill level has developed to allow the creation of new learning activities not possible without the technology.
5. **Innovation**—Teachers no longer try to adapt instruction to technology but adjust their fundamental perceptions of instruction. Teachers who reach this stage reflect on the actual craft of teaching, and their fundamental teaching approach may shift.

(Dwyer, Ringstaff, and Sandholtz, 1991)

The Concerns-Based Adoption Model (CBAM), like the ACOT studies, supports the notion that adopting any innovation takes time and support (Hord, Rutherford, Huling-Austin, & Hall, 1987). The CBAM model suggests that people progress through a series of developmental stages as they adopt any innovation and that their current places in the continuum must be considered at all times. There are seven stages and expressions of concern in the model; people gradually move from a personal perspective in the beginning stages to a concern for how the innovation might be expanded or used differently in the last stages of adoption. At all stages in the process, concerns and questions must be addressed, and continuous support must be sustained.

Different categories of software are better associated with the different levels of adoption as identified by this early research. Productivity tools are best suited to replicate seat-based work and complete traditional student activities, namely research papers and reports. Word processing applications are the most familiar productivity tools; others include spreadsheet and database applications. Productivity tools and drill-and-practice software—similar to traditional flashcards—are the most common applications utilized in

the earliest stages of software integration (Baker et al., 1993; Dwyer et al., 1991; Sheingold & Hadley, 1990).

What practices identify teachers on the far end of the technology integration spectrum? What software tools do experienced teachers use? Sheingold and Hadley (1990) studied 608 teachers in grades 4 through 12 who were described as experienced and accomplished users of technology. They found that many of these teachers (60%) utilized technology at least once a week to promote the creation of student products. While word processing applications were still the most widely utilized tools and were used at all grade levels, on average these teachers employed 14 to 15 different practices and related software types to accomplish instructional goals. Authors describe these experienced and successful teachers as multipurpose users.

Greater experience with technology enables teachers to incorporate a wider variety of software applications and approaches, enriching learning opportunities for the larger population of students. These new approaches often shift toward learner-centered rather than content-centered lessons and move beyond the typical classroom activities of lecture-based presentation and seatwork. These more familiar types of activities, which may be addressed by simple word processing and drill-and-practice applications, give way to curriculum-based software and research tools, allowing for greater individualized, creative, and interdisciplinary project-based activities.

Studies show that various software types also produce vastly different educational outcomes. Developmental software has been shown to provide significant benefits to young children. Haugland (1997) describes developmental software as open ended, providing learners with more control. Flexibility in learner control can actually determine the scope and sequence of an application. Benefits of developmental software include increasing users' intelligence, verbal and nonverbal skills, long-term memory, manual dexterity, and problem-solving and conceptual skills. What types of software can be considered "developmental" software? In the current study, developmental software includes "research tools" and "curriculum software" applications.

When used properly, computers may serve as important tools for improving student proficiency in mathematics (Welinsky, 1998). Proper use includes the selection and application of appropriate types of software. In a study of the relationship between different uses of educational technology and various educational outcomes, Welinsky found that using computers for drill and practice negatively impacted the academic achievement of eighth-grade

students. Furthermore, he found that using computers for learning games (academic games) was positively related to the academic achievement of fourth-grade students. Clearly, software type is a factor when considering the effectiveness of computers as learning tools.

Internet use was not common in earlier technology adoption studies, such as the reports on the ACOT program. Recent increased expenditures, easier access to the Internet, and the explosion of the World Wide Web have allowed teachers to expand beyond packaged software to include this resource as an instructional tool. How do teachers approach integrating Internet use in their classrooms? How does this differ from previous findings? Ravitz (1998) recently investigated instructional Internet uses by teachers experienced with this newer networked technology. In terms of use, 75% of the participants reported that all of the students had used the Internet in their classes; 70% reported spending at least an hour each week developing their own Internet skills or participating in Internet searches for instructional materials—clearly delineating an experienced sample. Technology use once again reflected technology experience.

Participants who scored higher on use were more likely to report that improved Internet access in their classrooms would help "a lot." Ravitz suggests that more frequent users might take greater advantage of improved access, opening them up to a possibly wider variety of instructional Internet uses. Of the teachers polled, 86.4% indicated their students had benefited from using the Internet; 56.7% indicated their students had *greatly* benefited from this use.

All the literature examined thus far focuses on individual teacher practices. The following study demonstrates that larger efforts supporting individual teacher practices can advance student achievement. The West Virginia Department of Education's recent long-term technology initiative successfully incorporated curriculum software and course management software (Mann, Shakeshaft, Becker, & Kottkamp, 1999). The statewide initiative, which featured large expenditures for hardware and teacher training and the use of curriculum software, is often credited with significantly increasing student scores on standardized tests. Schools participating in the initiative were given only two software sources, both of which were developed or adapted by the vendor to emphasize basic skills in reading and mathematics—areas targeted by the state. These software sources were aligned with West Virginia's statewide instructional goals and objectives. While software selection is not the only

variable in this program and its subsequent evaluation, significant gains in standardized measures were attributed to the statewide technology initiative. From this initiative, it seems likely that positive classroom changes can occur when states focus on individual teacher practices and provide hardware, software, and teacher training simultaneously.

A great deal of information is available regarding the disparity between the increased volume of recent technology purchases in our nation's schools and the apparent lack of use for instruction of these new purchases. In summarizing changes in education hardware and software purchases over the past decade, Sivin-Kachala and Bialo (1999) conclude hardware expenditures in schools increased 99,900% between 1991 and 1998 ($2.1 million to $2.1 billion). In this same period, software expenditures increased only 37% ($598 million to $822 million). Schools have invested in hardware, but the software that provides functionality to these materials has not been purchased. It is also widely expressed that teachers are not using technology for instruction despite recent expenditures (Cuban, 1999; Ely, 1995; Kent & McNergney, 1999).

What types of activities are classroom teachers engaging in with technology? Given what we know about the process of adopting new technologies and following the earlier evolutionary models of technology integration, where are classroom teachers in that process of development? How is software selection and use reflected in that process? This report provides part of the answer to these questions—at least, as they apply to survey respondents from Kentucky, Tennessee, Virginia, and West Virginia.

The information gathered by the Educational Software Use survey is derived from a random sample of K-12 public school teachers in Kentucky, Tennessee, Virginia, and West Virginia. A cover letter, color-coded survey, and incentive form were mailed to 4,000 teachers selected randomly from a database obtained from Quality Education Data (QED) of Denver, Colorado. Color coding of response forms permitted returns to be tracked by state. Of the 4,000 surveys distributed, 579 were returned—a response rate of 14.5%. The response rate was similar across the four-state region.

To encourage busy teachers to participate, a one-page survey was designed so it could be completed quickly, either by checking boxes or providing brief, often one-word, responses. Software was grouped into eight categories: drill and practice, curriculum, research tools, academic games, management, instructional simulations, computer-mediated communication tools, and productivity tools. Each category contained several examples of popular software, such as *Sim City* (instructional simulation); *Microsoft Office*, *Kid Pix* and *Digital Chisel* (productivity tools); and *Math Blaster* and *Word Munchers* (academic games).

Teachers were asked to indicate whether they had used software from each category daily, at least once a week, at least once a month, at least once a grading period, or never in their teaching. They were also asked to indicate whether the software had been used primarily to teach math, science, social studies, language arts, or other subject areas. In addition, teachers were asked to indicate their grade levels and subject areas if appropriate.

The results indicate that software, in general, is used infrequently in classrooms across the region, with 83.6% responding they *never* used software in their teaching. It appears that frequency of use among states is comparable, and no remarkable differences were noted. This figure is much higher than concurrent findings from other sources. Cuban (1999) reports that approximately 50% of all teachers never use computers. The most recent *Education Week* national survey, *Technology Counts '99,* does not address this statistic directly but reports that 38% of respondents indicated their students do not use computers in their classroom. Unlike the current study, the *Education Week* sample does not include all subject areas for teachers in grades 6 through 12, which may account for some of the disparity in findings (Edwards, 1999).

In examining the categories of use, the largest number of respondents employ productivity tools and research tools. Of the teachers reporting, 26.7% indicated they had used productivity software at least once a grading period, and 25.4% reported they had used research tools at least once a grading period. The popularity of productivity tools, such as word processing software, might suggest that teachers in the region are still in the early stages of technology integration. Previous studies (Dwyer et al.) indicated that text-processing

Key Findings

Of those responding to the survey:

1. 83.6% indicated they *never* use software in their teaching.
2. Productivity tools and research tools were the most frequently used software.
3. Curriculum software and instructional simulations were the least utilized software.
4. Drill-and-practice software was utilized *daily* by 9.5% of the respondents.
5. Within grades 9-12 content areas, the survey showed that
   - language arts and English teachers use productivity tools most often and curriculum and instructional simulations least often in teaching
   - math teachers indicated equal use of management software and productivity tools, while curriculum software was the least utilized category
   - science and social studies teachers report using research and productivity tools most often

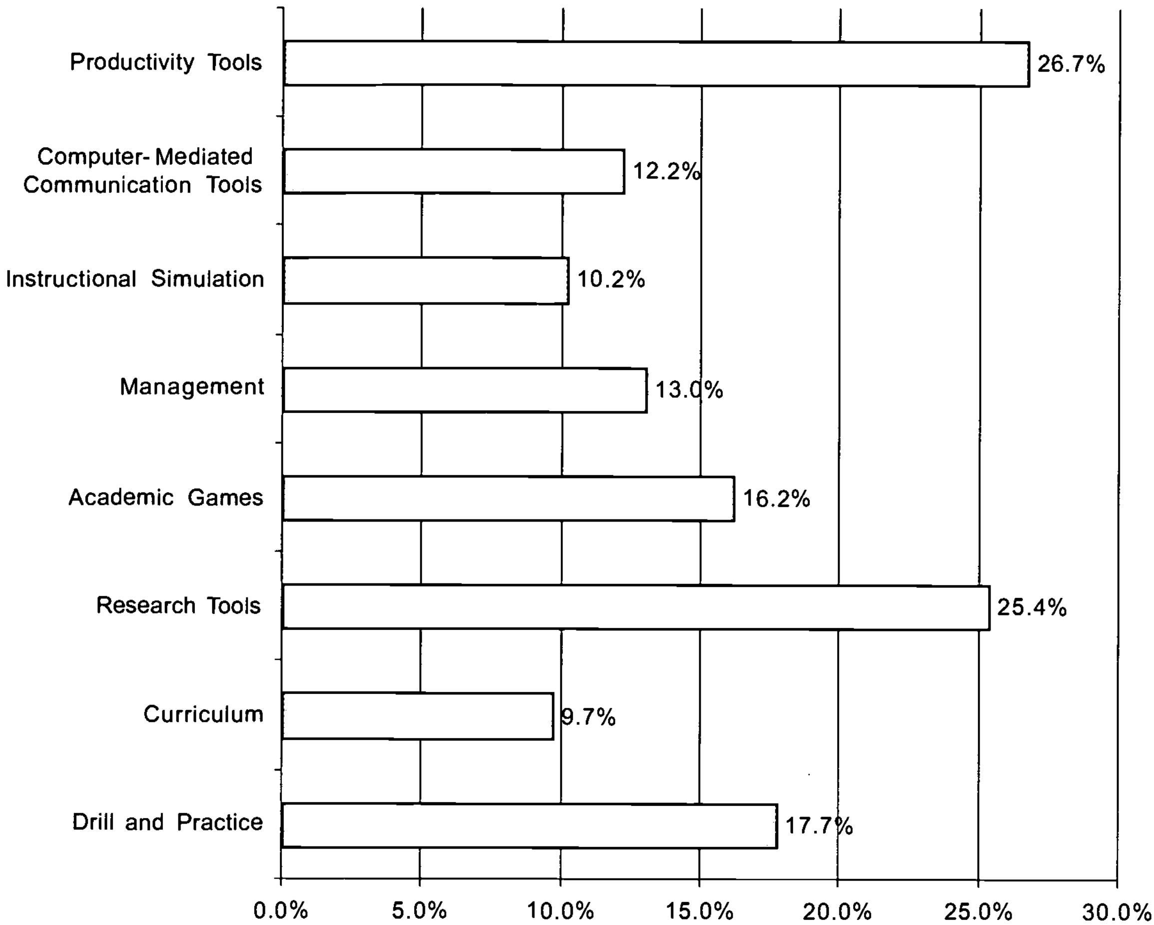

Figure 1. Percentage of Respondents Who Used Software at Least Once a Grading Period

software applications were the most popular tools in the early stages of technology integration because they replicated familiar seat-based activities. The presence of research tool use, however, might indicate the sample is shifting from the entry level of integration toward more learner-centered, product-based activities.

Curriculum software and instructional simulations appear to be the least utilized software across the region. Only 9.7% of respondents reported using curriculum software at least once a grading period. Similarly, only 10.2% used instructional simulations (see Figure 1). These findings suggest that little advancement has been made in encouraging software users to incorporate a variety of approaches and purposes for instructional technology. Most respondents have yet to begin the evolutionary cycle of multipurpose technology

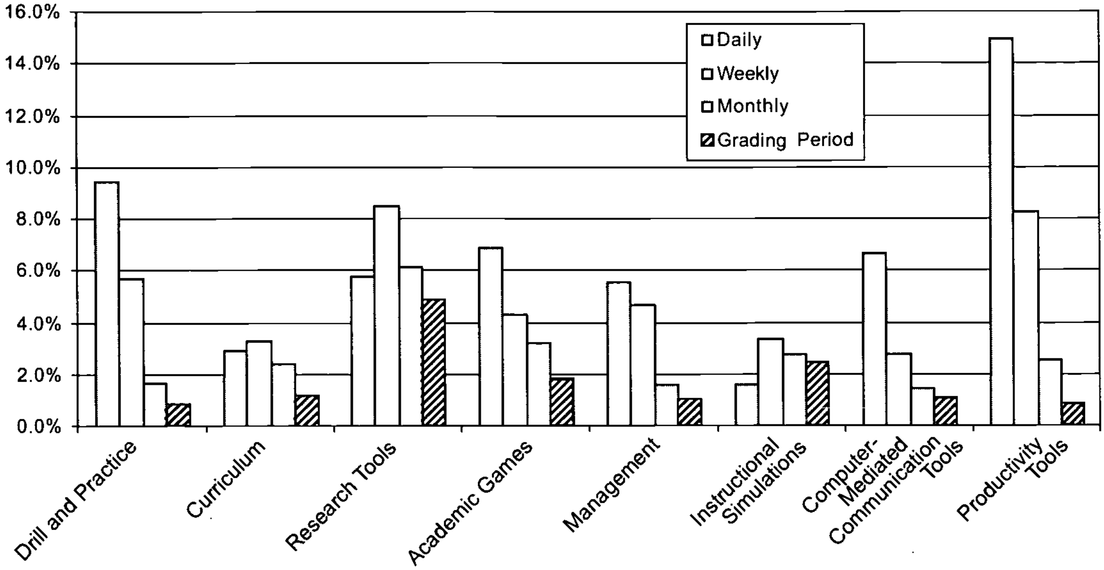

Figure 2. Percentage of Respondents Who Used Software Daily, Weekly, Monthly, or Once a Grading Period

integration, a cycle Sheingold and Hadley (1990) suggest takes five to six years. Among those who use software, a limited cadre of software tools and approaches are indicated, which suggests that even teachers who utilize technology in the classroom are far from being accomplished at it.

These previous statistics all refer to frequencies of software use by a number of respondents and are a compilation of the various levels of frequency. It should be noted that when shifting focus from percentage of users to daily use, 9.5% of the respondents utilize drill-and-practice software. This daily level is second only to productivity software (15%), further supporting the suggestion that respondents in the region are still in the earliest stages of software adoption and use. Although often maligned—one author refers to it as "drill-and-kill" software (Frank Smith, quoted in Casey, 1997)—drill-and-practice software is a common introduction to instructional computer use for novice users. Teachers use this type of software less often, however, as they become more accomplished users of technology (Sheingold & Hadley, 1990). While this is likely, we cannot discount the possibility that the use of drill-and-practice software lies not in a particular stage of development but in the structure of the learning environment. For example, students might rotate through labs on a daily or weekly basis; drill-and-practice applications, particularly those with management features, lend themselves to this setting. Daily

use, then, might simply indicate that students have a specified time each day to work on prescribed activities in a lab setting. A complete analysis of frequency of use by category is presented in Figure 2.

Teachers were asked to indicate the main subject area in which they used each category of software. For example, those using research tools daily were asked to indicate whether the tools are used primarily for math, science, social studies, language arts, or other subjects. Responses from teachers of grades 9 through 12 were compared within each subject area. These grade levels were chosen due to the teachers' relative subject autonomy as compared to elementary teachers, who are often responsible for several subjects.

Results among language arts and English teachers in grades 9 through 12 show that productivity tools were used most often and that curriculum and instructional simulations were used least often. The natural application of word processing and other text-processing applications to language arts, as well as the predominance of word processing software in all subject areas, clearly supports the expectations of this finding. The lack of communication tools, academic games, or curriculum software, however, suggests these language arts teachers still use software for more familiar, traditional classroom activities and do not capitalize on the application of language arts skills in a networked society. It is likely that the sample, in general, has yet to move to more student-centered, project-based instructional activities indicative of experienced users (see Figure 3).

Math teachers indicated equal use of both management software and productivity tools, with drill-and-practice software use indicated next. In addition to word processing, productivity tools include spreadsheet and database programs, which may influence the popularity of these tools. The creation and manipulation of spreadsheets, especially with their graphing capabilities, may be best suited for math classrooms. The indication that productivity tools and management software are used most often, with a secondary use of drill and practice, is consistent with the low level of technology integration throughout the sample. Curriculum software was the least utilized software type in math classrooms (see Figure 4).

Science and social studies teachers in grades 9 through 12 reported using research and productivity tools most often. Curriculum tools were used infrequently; however, academic games were the least utilized category of software by science teachers, while drill and practice was used least by social studies teachers. The popularity of research tools among science and social studies

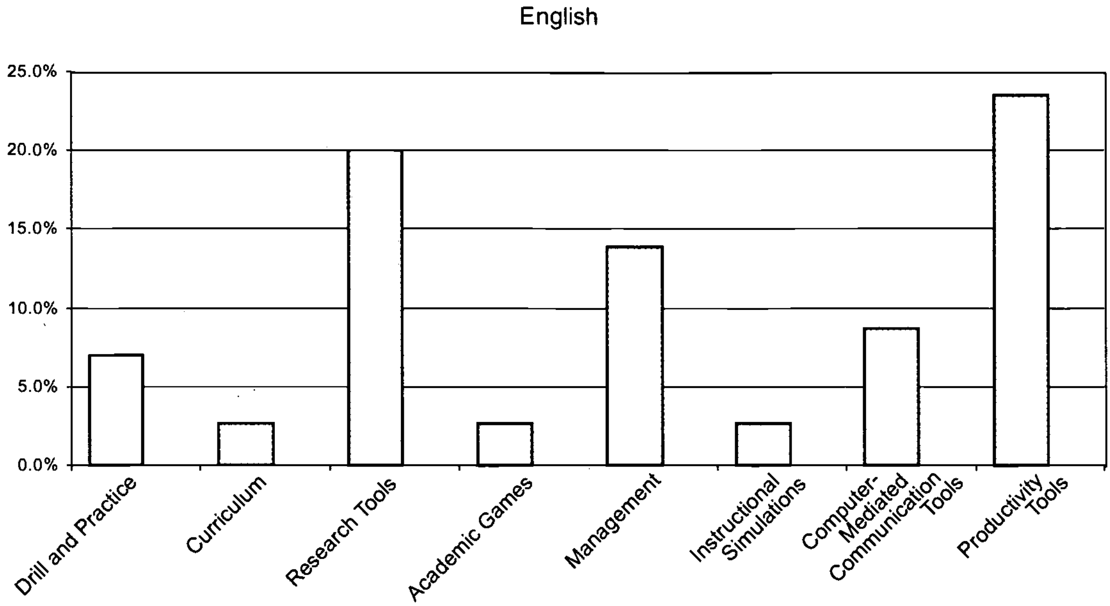

Figure 3. Percentage of Respondents in Grades 9-12 Who Used Software in Teaching English

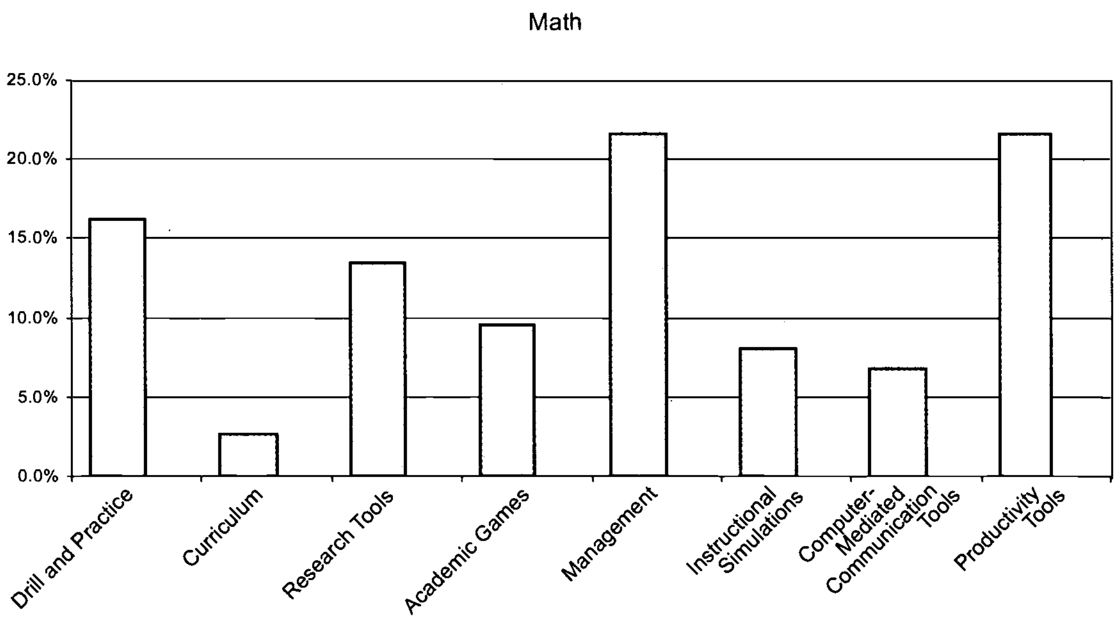

Figure 4. Percentage of Respondents in Grades 9-12 Who Used Software in Teaching Math

teachers, whether through CD-ROM encyclopedias or the Internet, might indicate some of these teachers have progressed beyond the rudimentary levels of technology integration in their classrooms. Another explanation, while not as promising, is that these disciplines lend themselves to greater use of the software tools (Figure 5 displays the categories and frequency of use by science teachers; Figure 6 refers to social studies).

Teachers in grades 9 through 12 who taught disciplines not previously mentioned indicated they used research tools and productivity tools most often, while the least utilized software categories for these same teachers included drill and practice, curriculum, and academic games (Figure 7 displays these results in greater detail).

Instructional simulations and curriculum software packages are available for many subjects, providing abundant resources and applications for a range of instructional settings; however, indications are that respondents rarely use these applications. The high usage of productivity tools might suggest that respondents are not developing innovative applications of technology but merely using technology to automate tasks such as calculations and report writing. On the other hand, the remarkably low use of curriculum software might indicate that much of the software available is not yet keyed to standards and assessments.

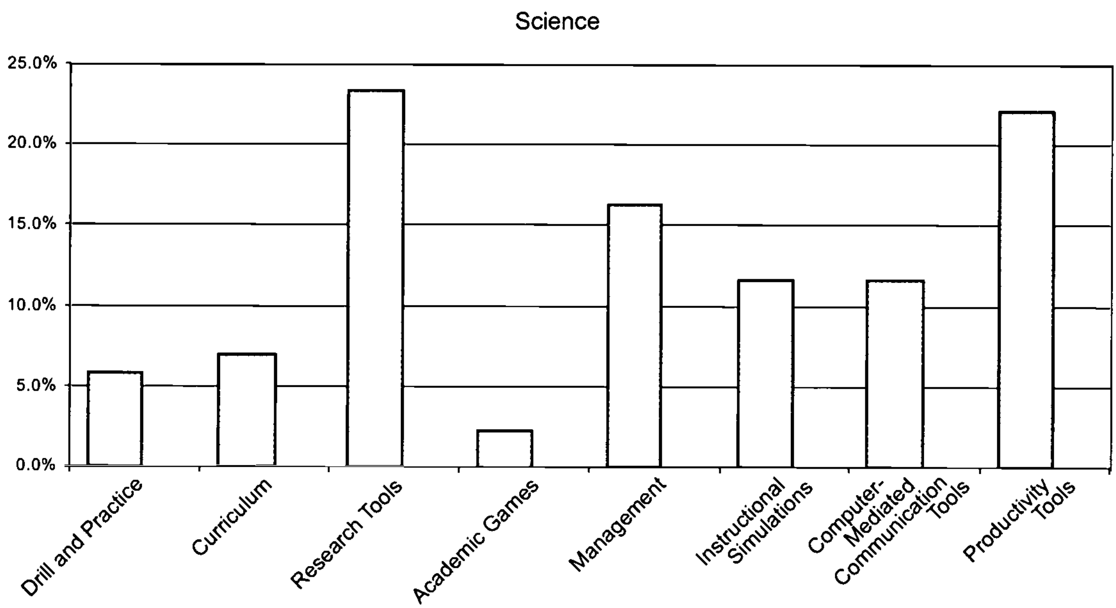

Figure 5. Percentage of Respondents in Grades 9-12 Who Used Software in Teaching Science

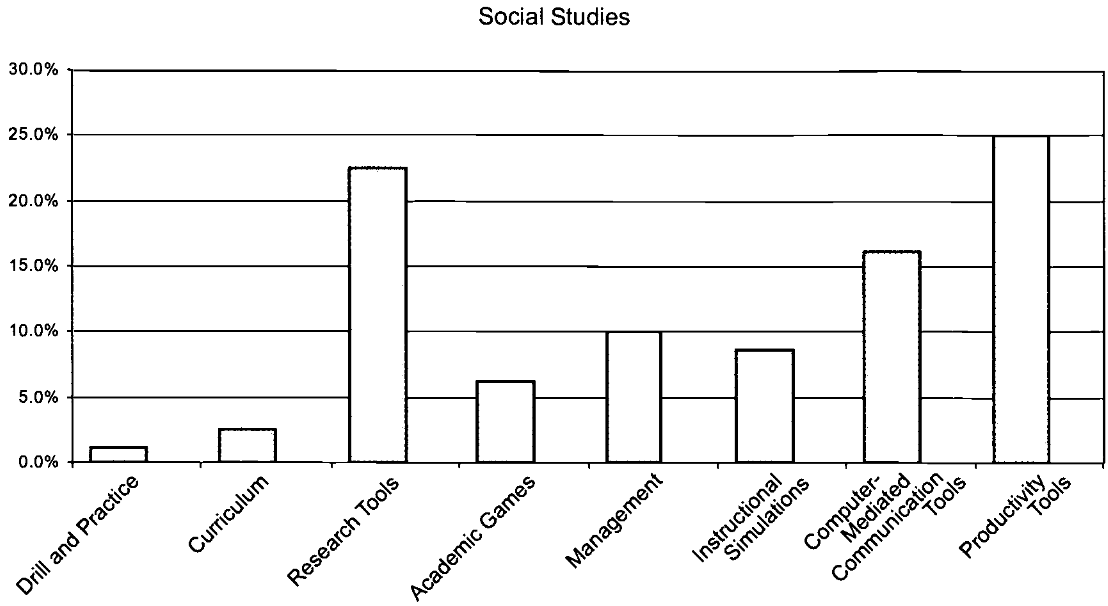

Figure 6. Percentage of Respondents in Grades 9-12 Who Used Software in Teaching Social Studies

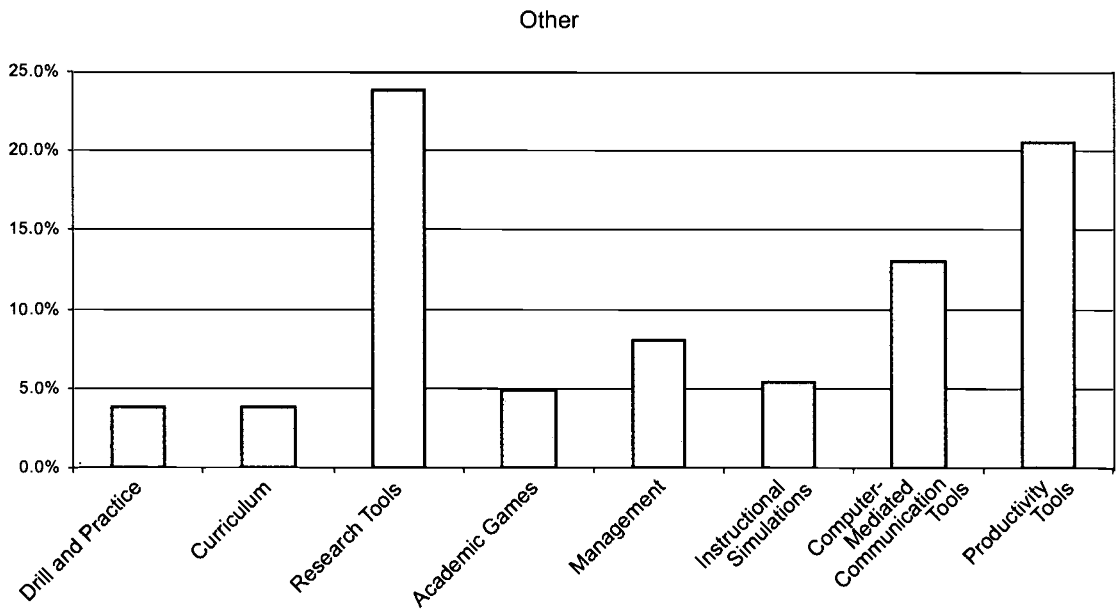

Figure 7. Percentage of Respondents in Grades 9-12 Who Used Software Teaching Subjects Other Than English, Mathematics, Science, or Social Studies

Based on this study, software use in teaching is limited in the four-state region and should be regarded as a paramount concern. The relatively high percentage of teachers who report *never* using software in their teaching comes as somewhat of a surprise; however, the results confirm other beliefs regarding software use in teaching. In the current study, the random sampling procedure, which included all subject areas in the K-12 range, may provide a clearer picture of total software use across the curriculum, as opposed to previous and concurrent studies that have limited respondents by user type or subject area.

Across all disciplines and grade levels, teachers use productivity tools and research tools most frequently, possibly indicating content-oriented rather than learner-oriented instruction. Despite the dramatic outpouring of concern by legislators and parents to incorporate technology into our nation's schools and the documented increase in spending to accomplish this, it is likely that educators in this sample are still at a rudimentary stage in their adoption of new technologies for teaching. Despite increased expenditures on hardware and training (Edwards, 1999; Schacter, 1999), the predominance of productivity tools mirrors the limited use of computers in education more than a decade ago. Software is readily available for the complete spectrum of age and ability levels represented in this study; however, it is likely the majority of teachers who incorporate technology limit its use to familiar classroom activities that are not necessarily performed better with technology.

Responses to why teachers do not use technology in the classroom commonly included insufficient teacher preparation programs, lack of training, and insufficient time for training (Cuban, 1999; Groves, Jarnigan, & Eller, 1998; Kent & McNergney, 1999; Ravitz, 1998). Educators are well aware that the resources of time and money are necessary for adopting new technology; however, indications are that money is being spent to stock schools with hardware and to provide teacher training. A variety of software types that support instructional goals and objectives must be provided for teachers to use in their classrooms. It is unclear in this study whether the lack of software use can be attributed to the respondents' failure to use software tools or if these tools have simply not been made available to them.

Telling schools that more staff development is needed will not sufficiently solve the problem of remedial use and nonuse demonstrated by respondents to this study. Valuable software products and approaches are available throughout the entire curriculum, and some successful teachers are well versed in

incorporating technology. However, the current study indicates that staff development must address skills needed to move beyond replicating familiar classroom activities on a computer. A variety of appropriate software, modern computers, and focused staff development must be deployed simultaneously. Help must be provided to propel teachers into becoming accomplished users of technology and to start nonuser peers on that same journey.

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Drill-and-Practice

Drill-and-practice software provides students with opportunities to practice concepts they have already learned. Usually the program provides feedback to students, and many drill-and-practice applications contain management features that enable teachers to track students' progress. Examples of drill-and-practice software include *Star Math, Accelerated Reader, CCC's Success Maker,* and *Skills Bank.*

Curriculum

Curriculum software supports instructional goals and objectives by providing or enhancing content. The multimedia design of much curriculum software addresses a variety of learning styles. Examples of curriculum software include *The American Girls, Magic School Bus Series,* and *A.D.A.M.*

Research Tools

Research tools include such materials as encyclopedias, journals, geographic references, atlases and other traditional reference materials that are now available in an electronic format. Many research tools are available in a CD-ROM format or on-line. In addition to the World Wide Web, on-line reference tools include subscription services such as *The Electric Library* and *Career Explorer.*

Academic Games

The video game industry has promoted many advantages in technology including the creation of sophisticated graphics and simulations. Academic games capitalize on these advances and may use these elements to present drill-and-practice exercises for learners, often with scoring options that promote the game experience. Academic games include *Math Blaster, Spell It,* and *Word Munchers.*

Management

A type of productivity tool, management software applications are used to manage data more efficiently. Common management tasks include grading and test creation and scoring. *Gradebook Plus, Integrade,* and *Make Test* are examples of management software.

Instructional Simulations

Simulations offer a variety of instructional experiences that might otherwise be too costly or impractical. Graphically realistic simulations may allow

students to perform dissections, mix chemicals, or visit other planets. Simulation software often requires students to apply verbal, computational, and attitudinal skills in hypothetical situations. Popular examples of simulation software include *Sim City, Oregon Trail,* and *Science Sleuths.*

Computer–Mediated Communication Tools

Computer-mediated communication tools support synchronous and asynchronous communication. E-mail applications, Web browsers, videoconferencing software, and groupware fall into this category. Examples of computer-mediated communication tools include *Eudora, Netscape Communicator, CU-SeeMe,* and *GroupSystems.*

Productivity Tools

This large category is often described as "tool software." Productivity tools are used to produce documents, spreadsheets, databases, images, or other products. Authoring tools, which are used to produce computer programs, also fall into this category. *Microsoft Word, ClarisWorks, HyperStudio, TimeLiner,* and *Kid Pix* are examples of productivity tools.

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